

# **Development of BMPs for Fertilizing Lawns to Optimize Plant Performance and Nitrogen Uptake While Reducing the Potential for Nitrate Leaching**

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## **Statement of Objective**

The problem addressed by this project is nitrate-nitrogen ( $\text{NO}_3^-$ -N) contamination of groundwater caused by fertilization of the approximate 679,426 acres of residential yards in California. Nitrate contamination of groundwater is an extensive problem in California. Fertilization of agriculture land and urban landscapes are a major source of  $\text{NO}_3^-$ -N contamination. Residential yards are the largest component of urban landscapes and lawns are the largest component of residential yards. Thus, a project involving the development of best management practices (BMPs) for fertilizing lawns to optimize plant performance and N uptake while reducing the potential for  $\text{NO}_3^-$ -N leaching focuses on a major urban source of  $\text{NO}_3^-$ -N contamination of groundwater. Since the project is on tall fescue, the most widely used lawngrass in California, the impact of this project is on a statewide basis. Including research sites in both southern and northern California (on mature and newly established tall fescue plots, respectively) provides a broader context in which to interpret the results. The objectives of this project are listed below.

1. Evaluate the annual N rate and source on tall fescue to determine which treatments optimize plant performance and N uptake while reducing the potential for  $\text{NO}_3^-$ -N leaching.
2. Quantify the effect of N fertilizer rate and source on: visual turfgrass quality and color; clipping yield, tissue N concentration, and N uptake; and concentration of  $\text{NO}_3^-$ -N in leachate at a depth below the rootzone.
3. Develop BMPs for the fertilization under representative irrigation practices of lawns to optimize plant performance and N uptake while reducing the potential for  $\text{NO}_3^-$ -N leaching.

4. Conduct outreach activities, including oral presentations and trade journal publications, emphasizing the importance of the BMPs and how to carry out these practices for N fertilization of lawns.

### **Executive Summary**

#### **Development of BMPs for Fertilizing Lawns to Optimize Plant Performance and Nitrogen**

**Uptake While Reducing the Potential for Nitrate Leaching** The problem addressed by this project is nitrate nitrogen ( $\text{NO}_3^-$ -N) contamination of groundwater caused by fertilization of the approximate 679,426 acres of residential yards in California. Nitrate contamination of groundwater is an extensive problem in California. Fertilization of agriculture land and urban landscapes are a major source of  $\text{NO}_3^-$ -N contamination. Residential yards are the largest component of urban landscapes and lawns are the largest component of residential yards. Thus, a project involving the development of best management practices (BMPs) for fertilizing lawns to optimize plant performance and N uptake while reducing the potential for  $\text{NO}_3^-$ -N leaching focuses on a major urban source of  $\text{NO}_3^-$ -N contamination of groundwater. Since the project is on tall fescue, the most widely used lawngrass in California, the impact of this project is on a statewide basis. Including research sites in both southern and northern California provides a better context in which to interpret the results.

Petrovic prepared a review paper entitled “The fate of nitrogenous fertilizers applied to turfgrass.” He summarized 11 papers on  $\text{NO}_3^-$ -N leaching from fertilizers applied to turfgrass and he concluded that leaching of fertilizer N applied to turfgrass has been shown to be highly influenced by soil texture; N source, rate, and timing; and irrigation/rainfall. If a significantly higher than normal rate of a soluble N source is applied to a sandy turfgrass site that is highly irrigated, significant  $\text{NO}_3^-$ -N leaching could occur. However, limiting irrigation to only replace moisture used by the plant, using slow-release N sources, and using less sandy soils will significantly reduce or eliminate  $\text{NO}_3^-$ -N leaching from turfgrass sites. Other research has shown that there is a negligible chance of  $\text{NO}_3^-$ -N leaching from turf. However, these findings are normally conditional as follows: water soluble fertilizers are not applied in excess; sandy soils are not heavily irrigated; turf is well maintained using standard agronomic practices including judicious use of fertilizers and irrigation; the turfgrass is not immature and the soil is not disturbed such as during establishment; and root absorption is not low because of dormancy, stress, or because of unhealthy turfgrass. In reality, home-lawn owners probably cause  $\text{NO}_3^-$ -N contamination of groundwater because they do not meet all the conditions that are required to not cause  $\text{NO}_3^-$ -N contamination of groundwater.

The objectives of this project, involving mature and newly established turfgrass plots, are to 1) evaluate the annual N rate and source on tall fescue to determine which treatments optimize plant performance and N uptake while reducing the potential for  $\text{NO}_3^-$ -N leaching; 2) quantify the effect of N fertilizer rate and source on visual turfgrass quality and color, clipping yield, tissue N concentration and N uptake, and concentration of  $\text{NO}_3^-$ -N in leachate at a depth below the rootzone; 3) develop BMPs for lawns under

representative irrigation practices to optimize plant performance and N uptake while reducing the potential for  $\text{NO}_3^-$ -N leaching; and 4) conduct outreach activities, including oral presentations and trade journal publications, emphasizing the importance of the BMPs and how to carry out these practices for N fertilization of lawns.

This project was conducted on plots located at the UC Riverside (UCR) Turfgrass Research Facility and at the field facilities of the UC Davis (UCD) Department of Plant Sciences. The UCR plot was seeded to Marathon III tall fescue in Apr. 1996 and was a mature, uniform stand. The plot at UCD was sodded to Marathon III tall fescue in Oct. 2002. At both sites the experimental design was a randomized complete block (RCB) design with N source and rate treatments arranged in a 4 H 3 factorial. The N sources included ammonium nitrate, a fast-release, water soluble N source; Polyon, a slow-release, polymer-coated N source; Milorganite, a slow-release, natural organic N source; and Nutralene, a slow-release, water insoluble, methylene ureas N source. Each fertilizer was applied at the annual N rate of 4.0, 6.0, and 8.0-lb/1000 ft<sup>2</sup>. Nitrogen treatments were applied to 5- H 7-ft plots by hand to ensure accuracy. The plots were irrigated at 110% ETo and the amount of irrigation was determined each week based on the previous 7-d cumulative ETo, obtained from an on-site CIMIS station. There were three irrigation events per week. The plot was mowed one time per week using a walk-behind, rotary mower set at 1.5 inch mowing height; clippings were collected. Measurements included visual turfgrass quality and color ratings, clipping yield, tissue N concentration and N uptake, and  $\text{NO}_3^-$ -N concentration of soil water below the rootzone. Treatments and measurements were conducted from Oct. 2002 to Oct. 2004 at UCR and from May 2003 to Dec. 2005 at UCD.

Based on data collected during this study, several BMPs were developed and are listed below.

1. Minimalist irrigation reduces the potential for nitrate leaching. However, sufficient irrigation is needed to promote healthy turfgrass.
2. An annual N rate of 4 to 6 lb/1000 ft<sup>2</sup> produces an acceptable to good quality tall fescue lawn. Higher rates are not necessary and increase the risk of nitrate leaching.
3. Slow-release N sources (Nutralene, Milorganite, and Polyon) cause less nitrate leaching than a fast-release N source (ammonium nitrate).
4. The amount of nitrate leaching from a fast-release N source can be drastically reduced if N rates of individual applications do not exceed 1.0 to 1.5 lb/1000 ft<sup>2</sup>.

During this project, there were 20 outreach activities, so we believe the information related to the topic was well conveyed. During the second half of the project, the topic of BMPs was emphasized. Adoption of BMPs can occur over time if the information continues to be conveyed to the general public.